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Multi-Sensor Data Fusion Experiment
Preliminary Report on Processing, Analysis and Data Fusion Approach

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U.S. Geological Survey

Goals

- Study the use of multiple sensors to identify surface materials for chemical hazards assessment
- Develop tools required to prepare multi-source imagery for use in chemical hazards assesment
  - Characterization of individual image sources
  - Data preparation
  - Analysis
- Example application at government test site

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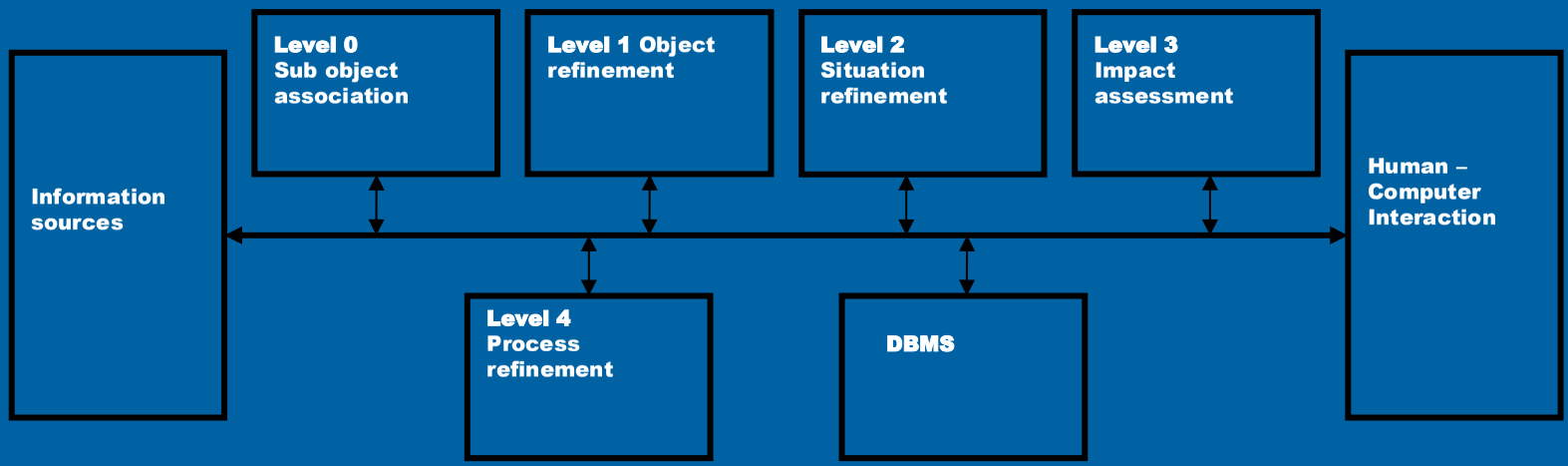
Data Fusion Framework



U.S. DoD, JPL. 1991. Data Fusion Subpanel of the Joint Directors of Laboratories (JDL), Technical Panel for C3, "Data fusion lexicon,"

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Automated Fusion of Image Data Systems (AFIDS)

- Developed at JPL to co-register multi-source imagery
- Handles a variety of sensors, projections, resampling methdods
- Assumes “internal” geometry (=interband) registration of individual sensors is accurate
  - ALI: wide focal plane array affected by terrain-induced parallax
  - Hyperion: different imaging mechanisms between VNIR & SWIR

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Hyperion Processing

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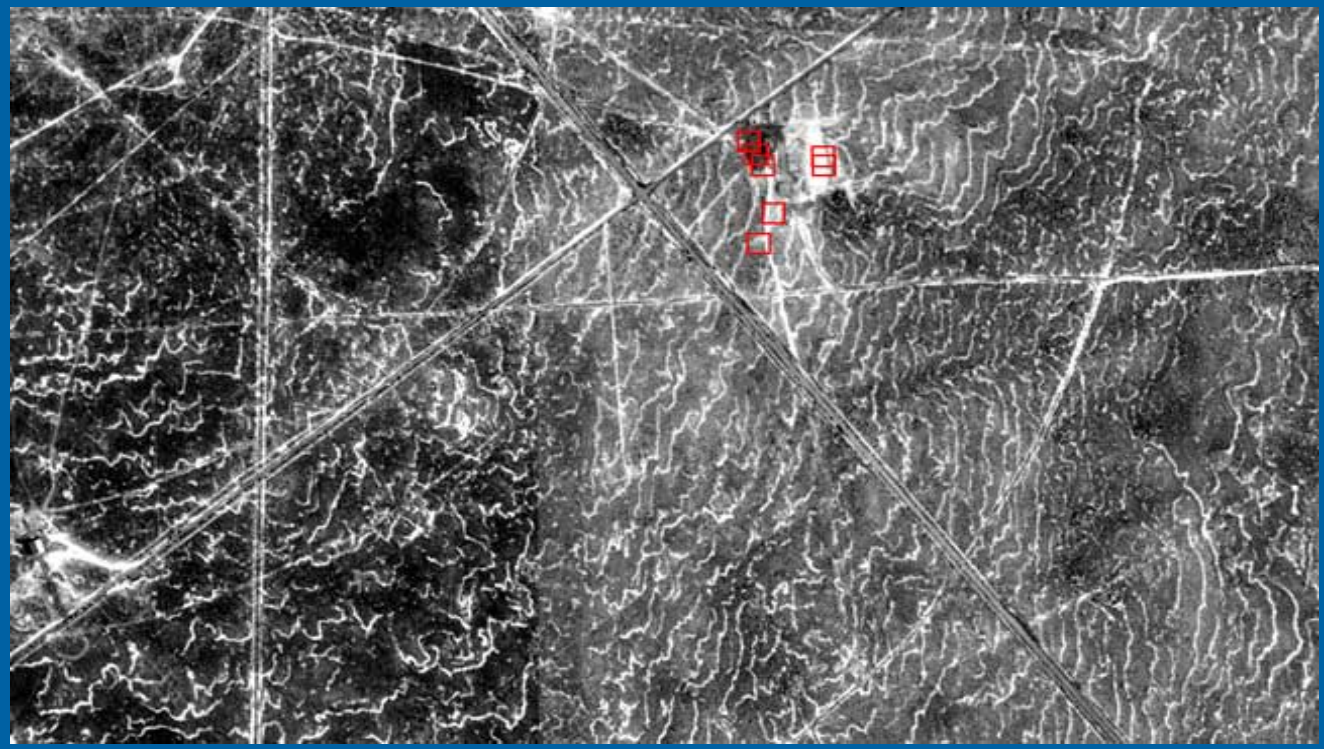
Site context (1-meter DOQQ)



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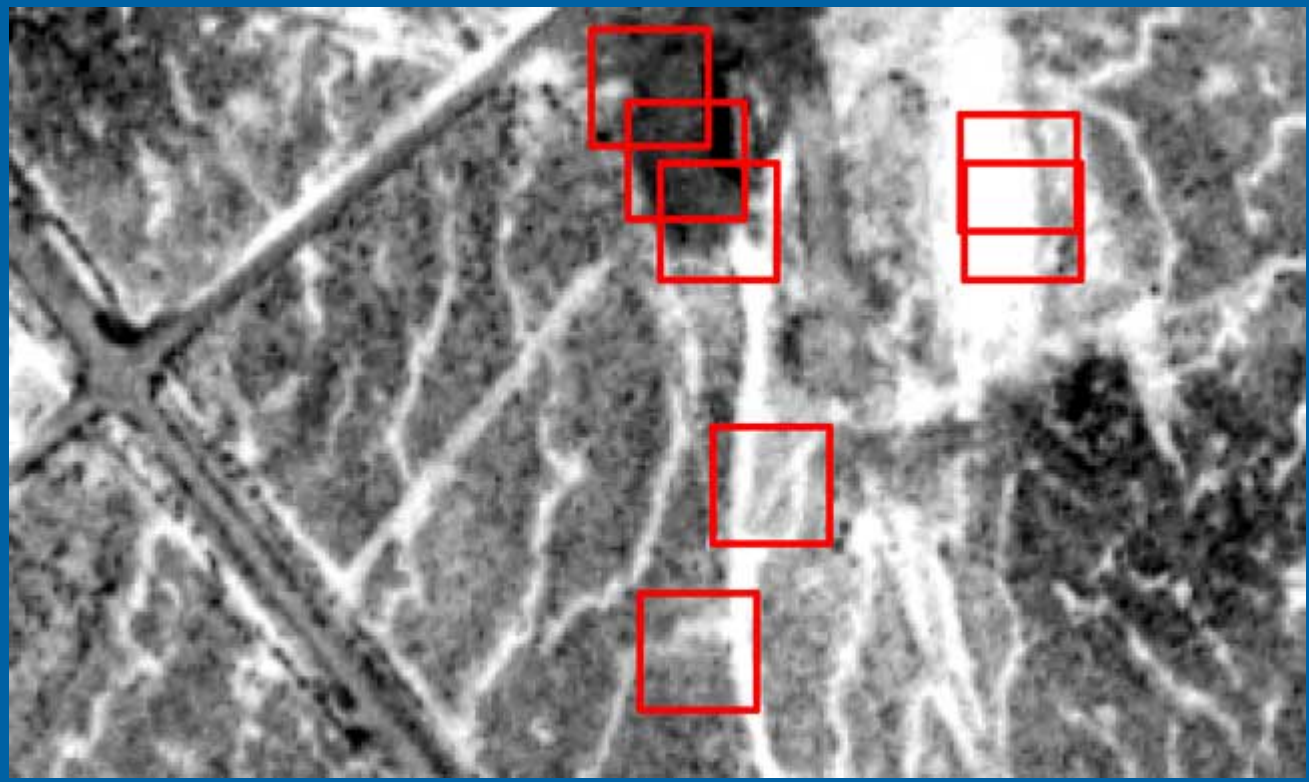
Site detail



30-meter “pixels” at site locations – mixing problem

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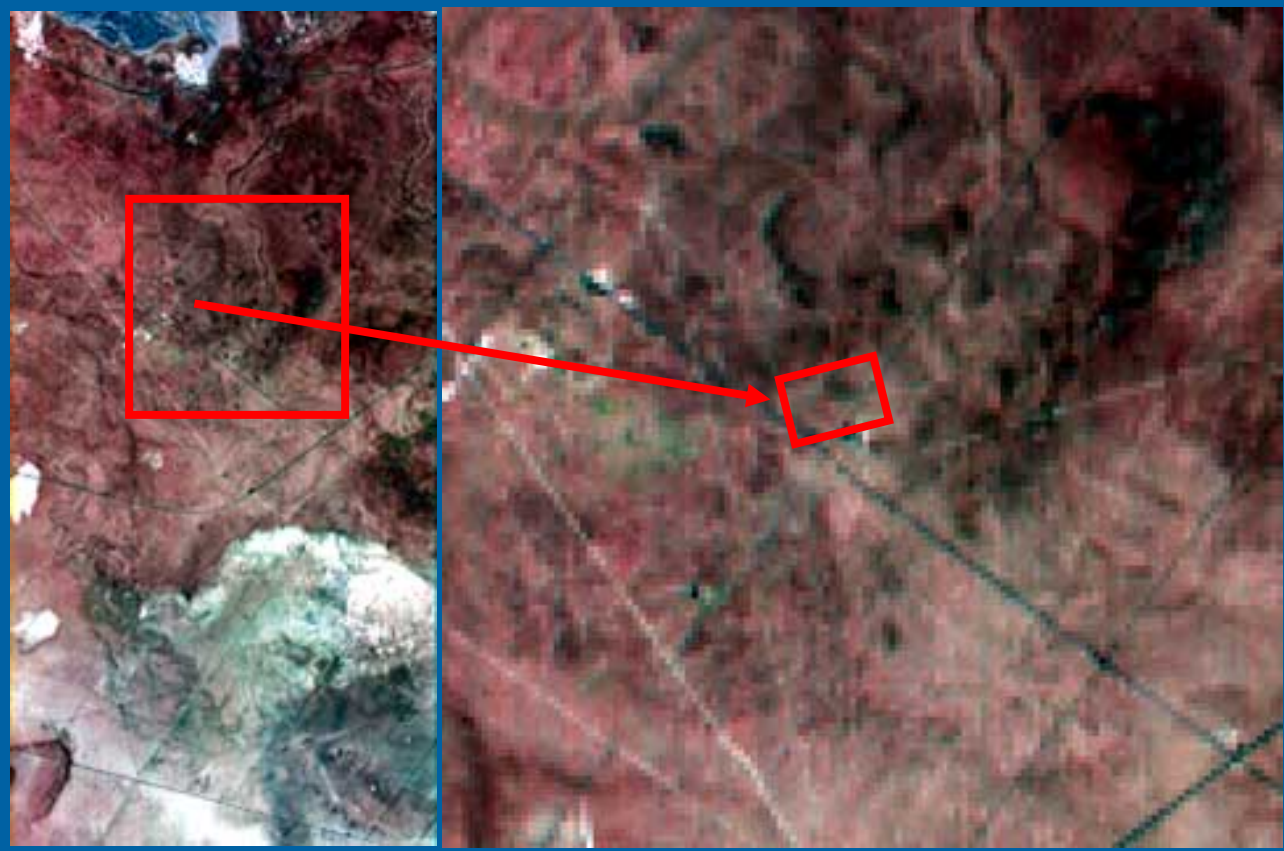
Context: Hyperion Imagery



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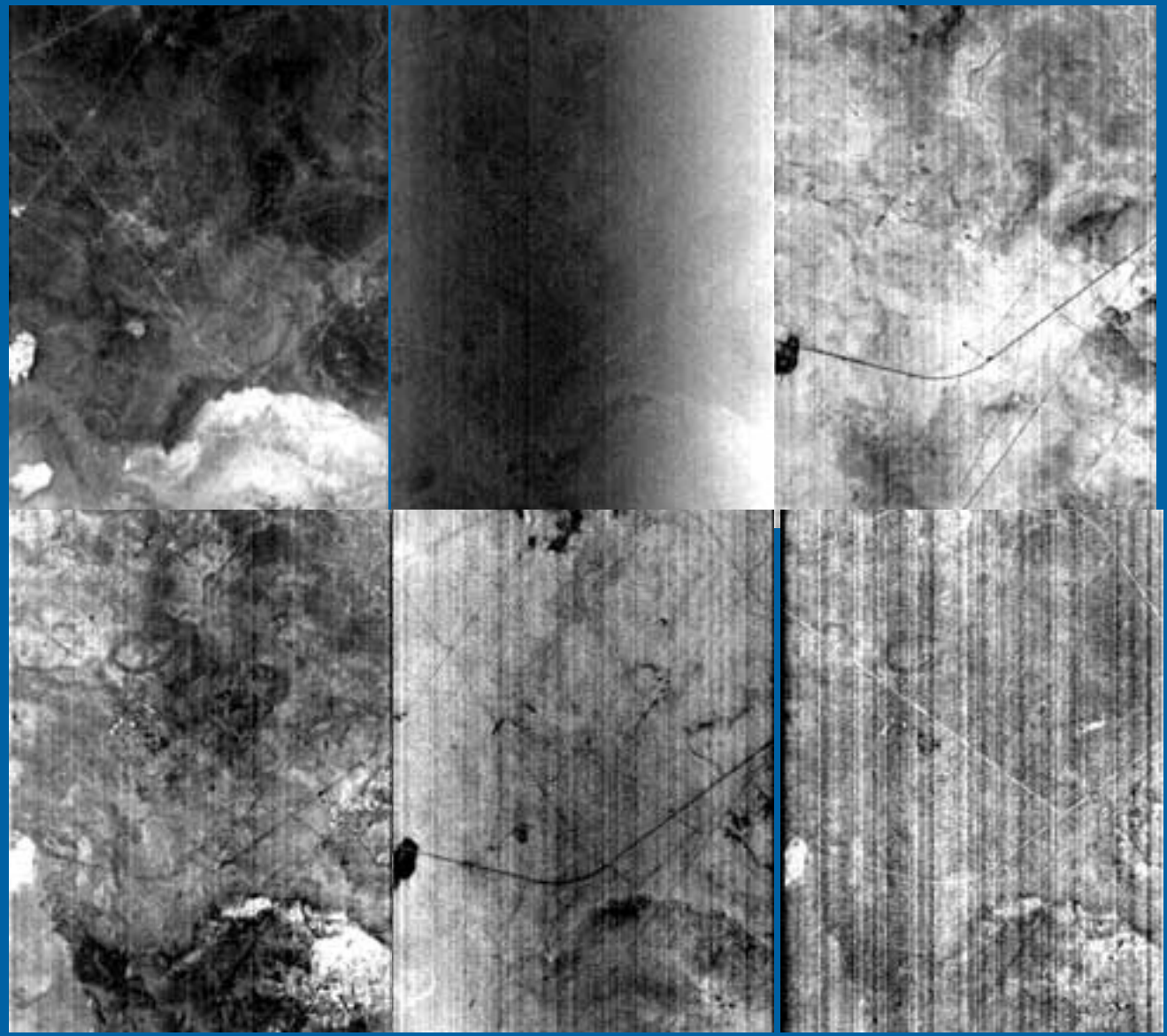
Hyperion: MNF transform

Note: various Artifacts:

- "Smile"
- Detector miscalibration
- Dead or noisy detectors



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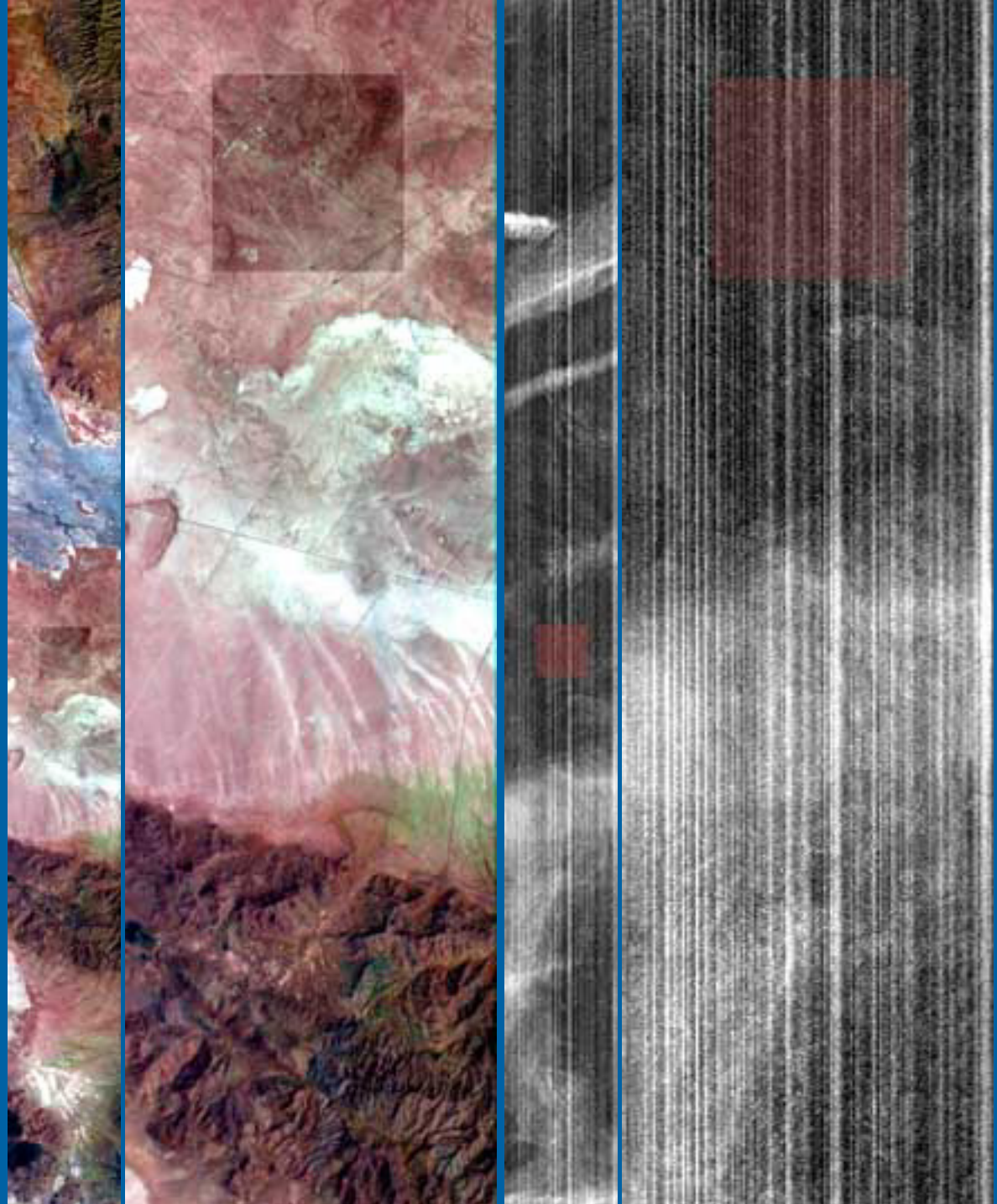
Cirrus cloud
Detection
(138nm)



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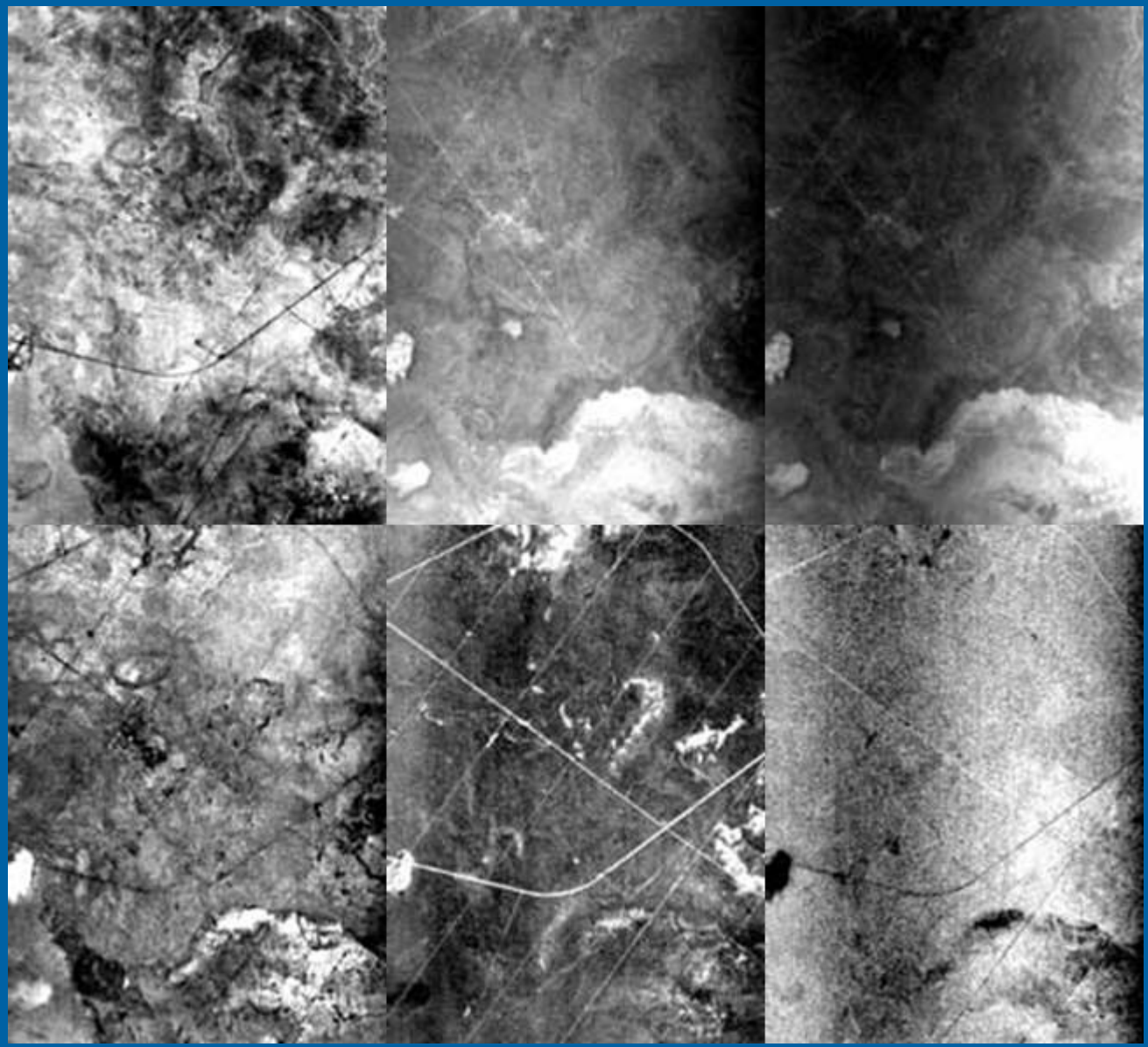
After corrections (MNF):

- Atmospheric correction
- Relative calibration
- Cirrus avoidance
- Dead detector removal



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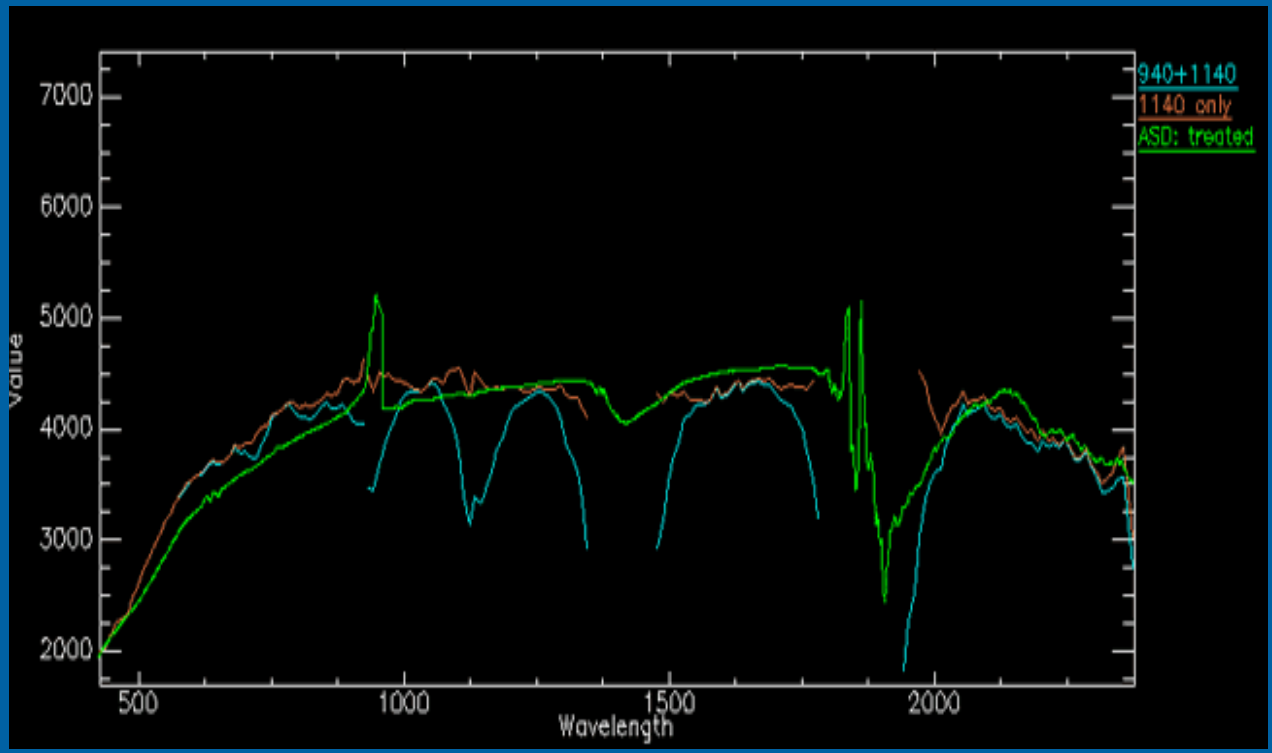
Field spectra (empirical atmospheric correction)



940 nm water vapor feature “corrupted” by surface reflectance

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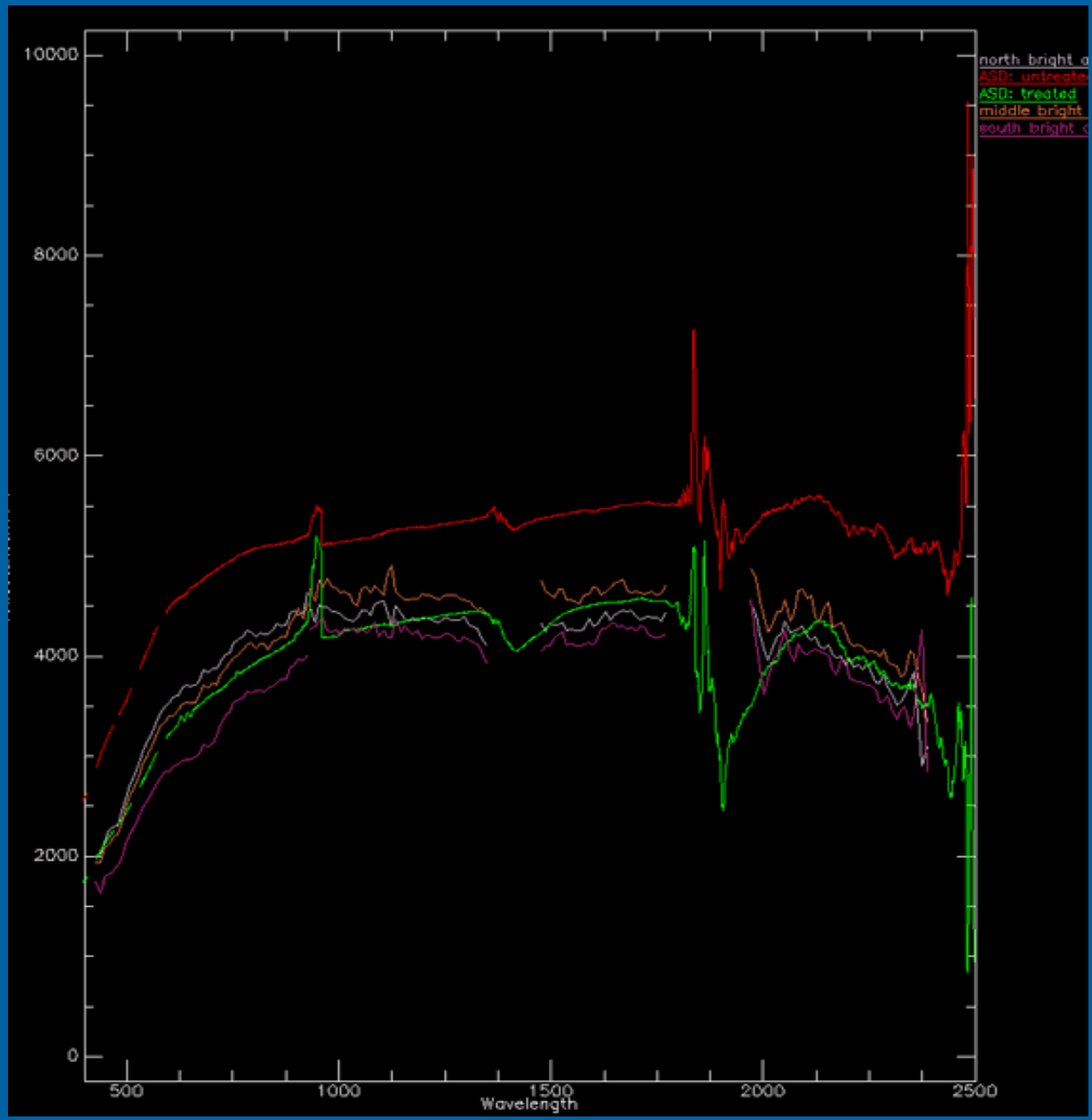
Image spectra
•Captures shape of field spectra, but not amplitude



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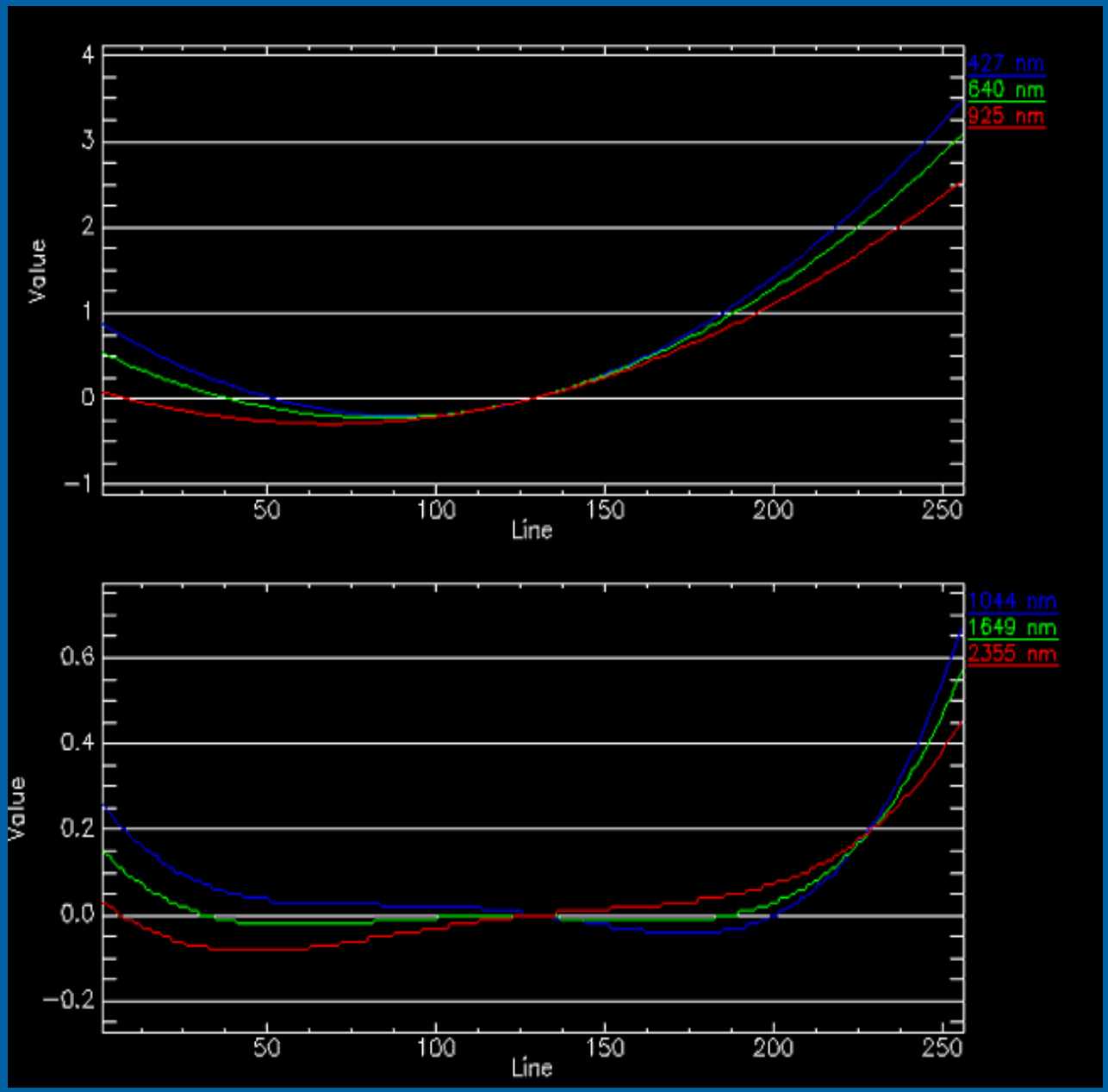
Spectral Smile (“Value”=reflectance units)



VNIR

SWIR

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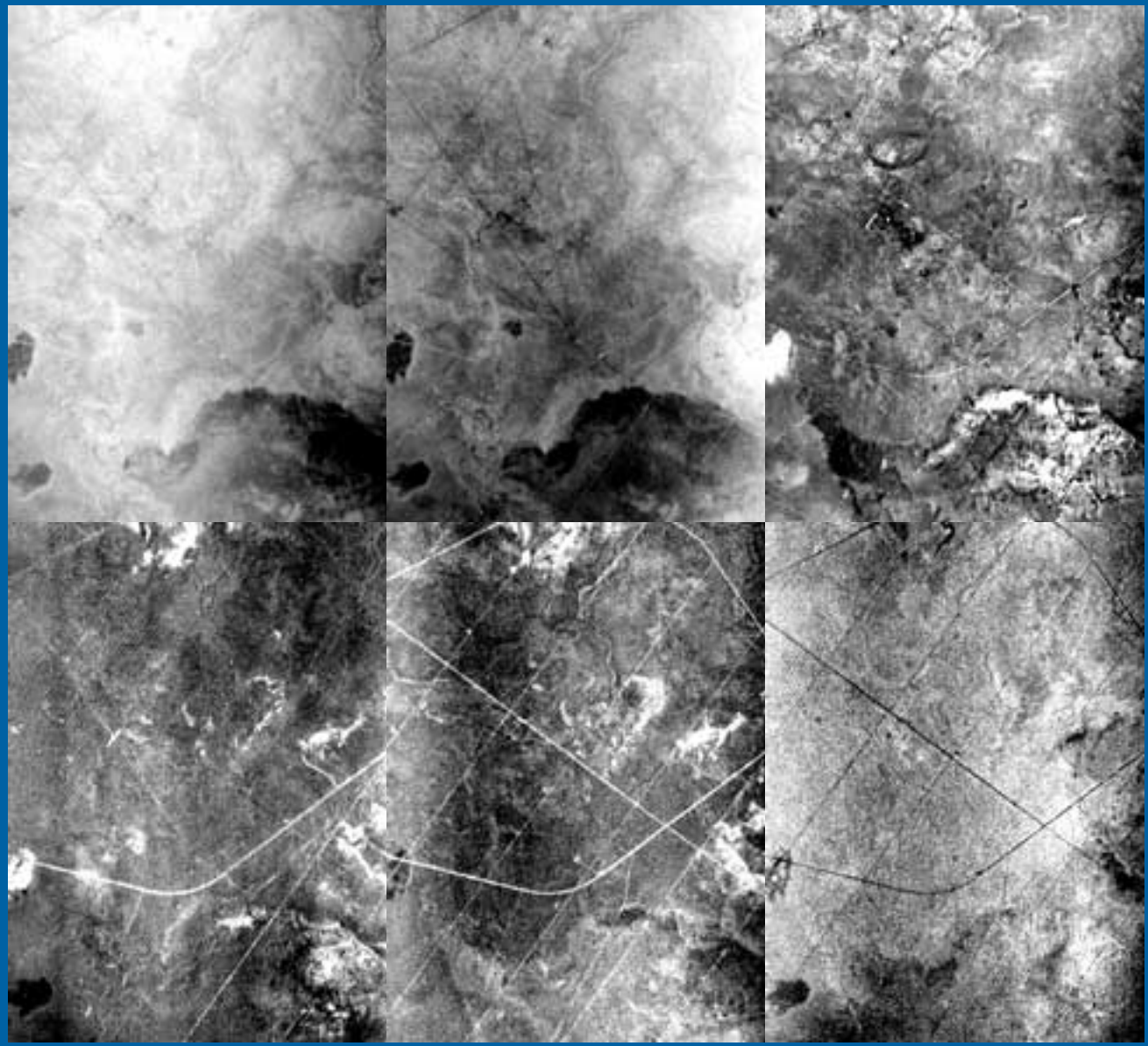
MNF: VNIR only (“smile” present)



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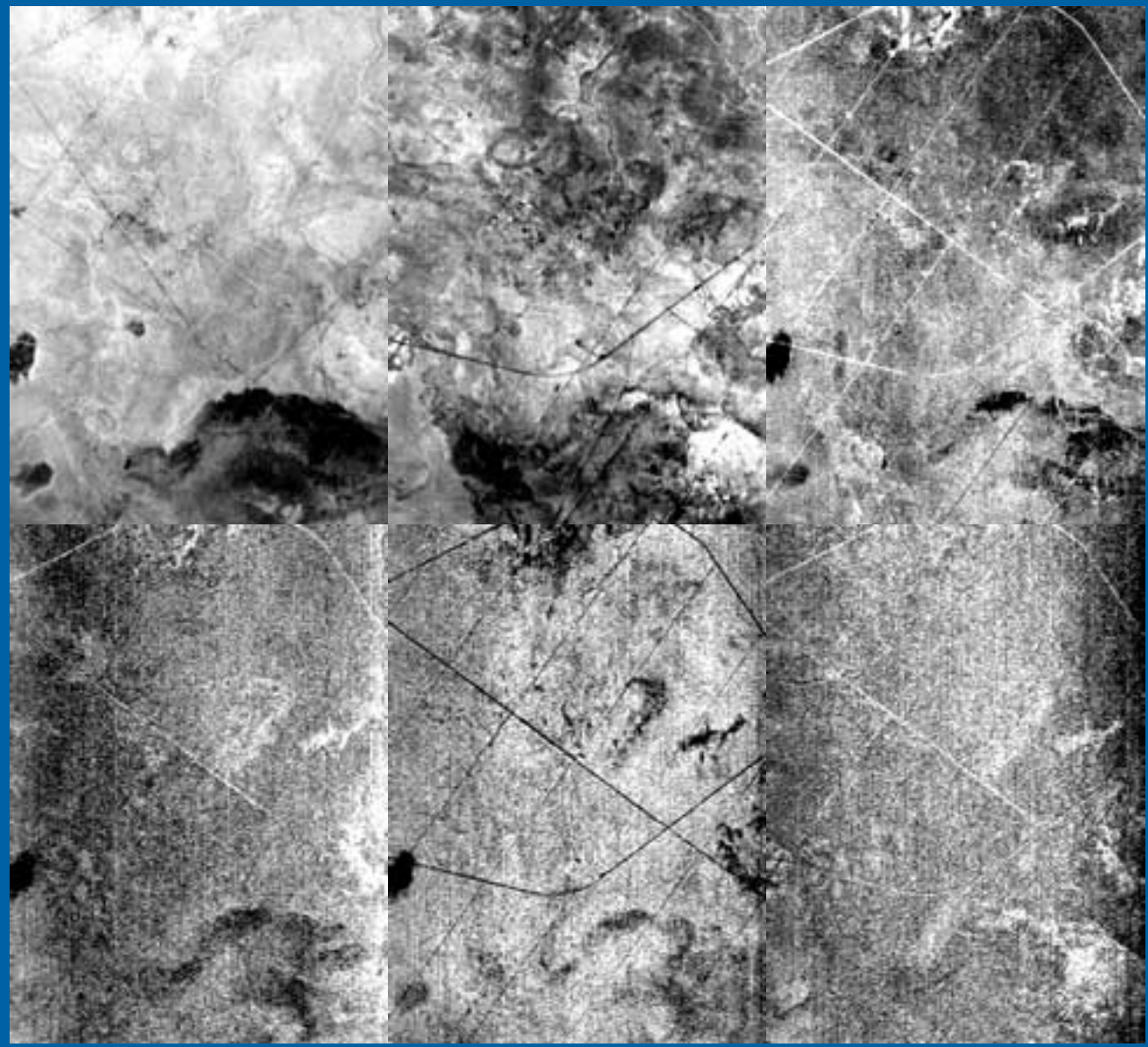
MNF: SWIR only

- Noisier, but no “smile”



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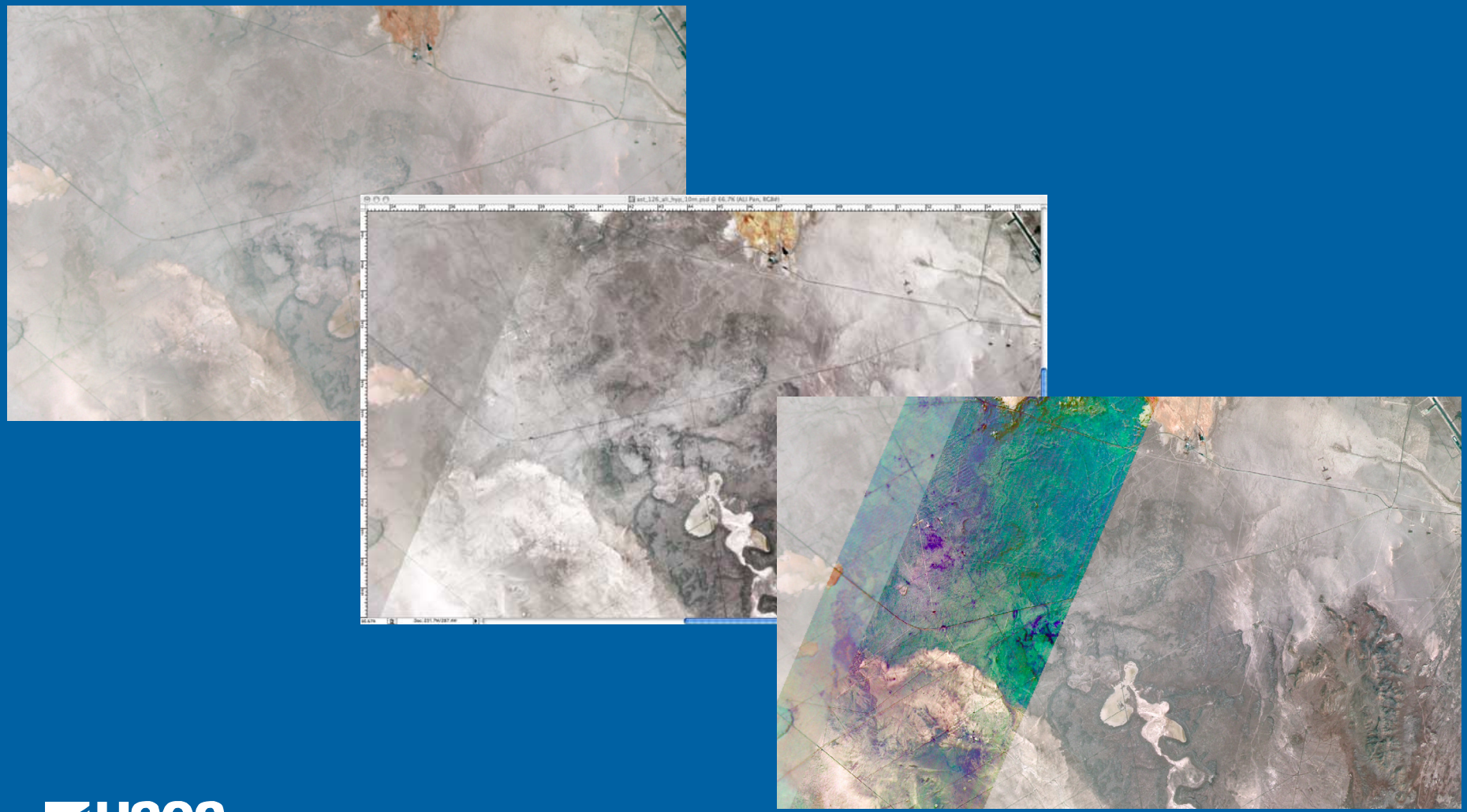
Fusion: ASTER (TIR), Hyperion (MNF) and ALI (10-meter pan)



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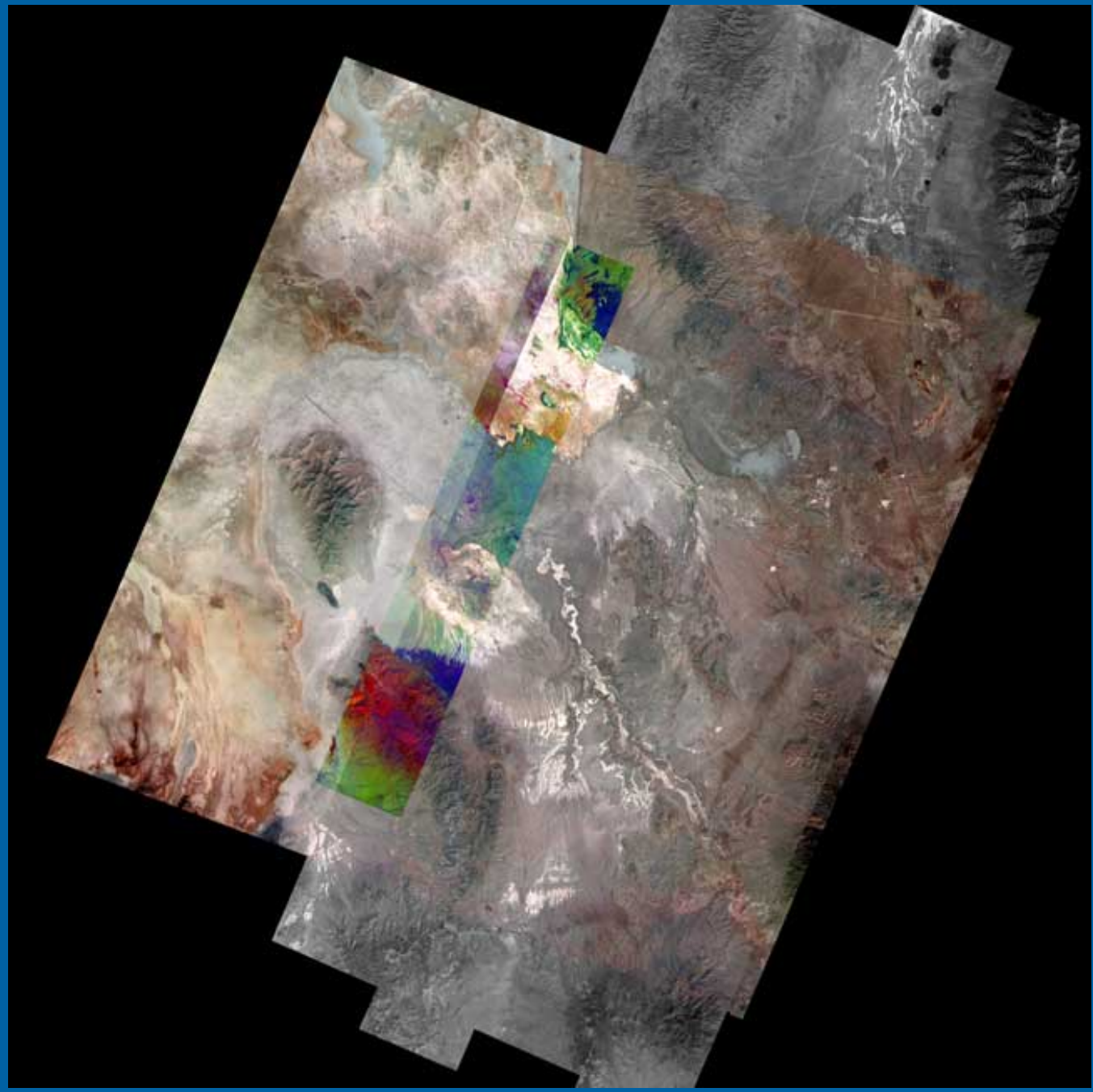
ASTER/Hyperion /ALI “Fused” dataset:

- Different resolutions (how to aggregate “information”?)
- AFIDS improvements: resampling, projections, sensors used
- Analytical tools (multi-source information extraction)



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